Specialized computer algebra system for application in general relativity

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Abstract: A brief characteristic of the specialized computer algebra system GRG_{EC} intended for symbolic computations in the field of general relativity is given.

The code GRG_{EC} constitute a full-fledged programming system intended for application in the field of the general relativity and adjacent areas of the differential geometry and the classical field theory. Written mostly in the lisp dialect known as STANDARD LISP, it is realized, structurally, as the top layer upon the universal computer algebra system *Reduce*. The latter is utilized as the primary tool for execution of the general kind symbolic mathematical calculations. The code infrastructure includes, in particular, the user interface based on the interpreter of the so called *language of problem specification* which models the natural language in its simplified version adapted to the description of the notions and relationships taking place in the application field. The collection of algorithms implementing the set of *data objects* and the rules of operations with them models the most important notions and relationships (equations) established in the relevant areas of the physics and the geometry. One could note in this respect implementation of the calculus of exterior forms, the spinor algebra tools, the major elements of the tensor calculus. (All these techniques operate with separate object components, no abstract index methods have been implemented). The application specific algorithms enable one, in particular, to handle various bases in foliations of exterior forms connected with the metric structure, the connection, the curvature with its irreducible constituents and invariants, the equations connecting the above objects such as Cartan equations, Bianchi equations, various algebraic identities, the field equations of the gravity theory (Einstein equations). The handling of a number of the classical field has been implemented including electromagnetic field, massless spinor field, massive spinor fields, massless scalar field, conformally invariant scalar field, massive scalar field and others. It is worth noting also the feasibility to manipulate with Newman-Penrose spin coefficients, Lanczos representation of the conformal curvature, Rainich theory of the coupling of electromagnetic and gravitational fields, Killing vectors and more.

GRG_{EC} is currently available free of charge at `http://grg-ec.110mb.com`